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I. Physiology of the Cardiovascular System, Respiration and Exercise

THE EFFECT OF INTERPOLATED EXTRASYSTOLE ON ACTION POTENTIALS AND ISOMETRIC CONTRACTIONS OF THE RIGHT VENTRICULAR PAPILLARY MUSCLES OF NEWBORN AND ADULT RABBITS. P. Pučelík, F. Barák, Department of Physiology, Faculty of Medicine, Charles University, Pilsen, Czech Republic.

The aim of our study was to ascertain and measure the differences in the frequency sensitivity of the working ventricular myocardium in newborn and adult rabbits. The effect of an interpolated extrasystole was simultaneously measured on both the action potential and isometric contraction of papillary muscles from the right ventricle in adult and newborn rabbits. While the adult myocardium exhibited characteristically pronounced postextrasystolic potentiation, this property was not found in the newborns. The results suggest that the mature sarcoplasmic reticulum plays the key role in the determination of frequency sensitivity. The morphologically and functionally immature sarcoplasmic reticulum in newborns corresponds to the low frequency sensitivity.

THE POSTNATAL DEVELOPMENT OF CALCITONIN RELATED PEPTIDE IN THE RAT ATRIUM, STUDIED WITH IMMUNOFLUORESCENCE. J. Slavíková, A. Dahlström¹, Department of Physiology, Charles University, Pilsen, Czech Republic and ¹Institute of Neurobiology, University of Göteborg, Sweden.

The developmental pattern and distribution of the calcitonin gene-related peptide (CGRP) in immunoreactive nerves of the rat heart have been studied by indirect immunofluorescence. Anti-CGRP and monoclonal antibodies against the synaptic vesicle antigen SV2 were applied to whole mount-stretch preparations of the right atria from hearts of newborn to 40-day-old animals. Immunofluorescence was studied with conventional and confocal laser scanning microscopy. Nerve fibres with CGRP- and SV2-like immunoreactivity (LI) were already present throughout the atria at birth. A gradual increase in the density of innervation was observed up to the age of 40 days. The number of SV2-positive nerve terminal fibres was larger in all the areas studied. In axon bundles, CGRP-LI was very prominent, while the SV2-LI was not seen. CGRP-LI does not coincide with the localization of the SV2 antigen in the same nerve fibres and terminals.

THE EFFECT OF DIETARY N-3 FATTY ACIDS ON MYOCARDIAL FUNCTION IN HYPERTRIGLYCERIDAEMIC RATS. H. Vavříčková, M. Tutterová, A. Vrána, I. Smrčková, Institute for Clinical and Experimental Medicine, Prague, Czech Republic.

Fish oil (FO), rich in n-3 fatty acids (FA), is recommended to patients with hyperlipidaemia on account of its hypolipaeamic effects. However, little information is available on the consequences of an increased intake of n-3 fatty acids at organ level, mainly on the heart. We therefore monitored, using a model of genetically hypertriglyceridaemic (HTG) rats, with lipaemia potentiated by a high-saccharose diet (HSD), 65 cal%, the effect of FO on the function of the isolated working heart and its resistance to ischaemia. HTG rats were fed either a standard diet (SD) or an HSD diet supplemented with 10 % weight of lard (HSD-L) or 10 weight % of FO (HSD-FO) 21 days before decapitation. The monitored functional parameters of the hearts were identical in all three groups. Contrary to what we expected, resumption of myocardial function (aortic flow) after 20 min of global ischaemia was significantly lower in HSD-FO compared with HSD-L and SD, even though FO had a beneficial effect on some of the metabolic parameters (decreasing serum TG and non-esterified FA, decreasing TG levels and raising glycogen levels in the heart). ATP levels in the heart decreased to "critical values" (10 $\mu\text{mol/g d.w.}$) in all groups. One of the factors affecting myocyte viability may be the composition of phospholipid FA of myocardial membranes in HSD-FO.

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PROTEIN REMODELLING IN CARDIOMEGALY INDUCED BY PRESSURE OVERLOAD IN NEONATAL RATS. J. Černohorský, V. Pelouch, M. Milerová, B. Ošádal, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

A gradual pressure overload was induced in 2-day-old rats by banding the abdominal aorta to a template 0.25 mm in diameter. In 30-day-old experimental animals the left ventricular (LV) weight was increased by 50 %, the right ventricular (RV) weight by 25 % and in 60-day-old rats by 63 % and 13 % (LV and RV respectively). The content of total collagenous proteins (all extracellular matrix components) and non-collagenous (contractile and sarcoplasmic) proteins in the hypertrophied LV was already increased in 30-day-old rats. The elevation of the concentration of both pepsin-soluble (higher amount of collagen III) and pepsin-insoluble (collagen aggregates) proteins was observed only in 60-day-old rats. The concentration of non-collagenous proteins in this age group was, however, significantly lower, due to the lower concentration of the sarcoplasmic fraction. The above changes of the protein profile were significantly less pronounced in the hypertrophied RV; the elevation of the content of total collagenous and contractile proteins in 30-day-old animals was the only difference from the controls. On the other hand, the hydroxyproline content was elevated in both ventricles and both age groups. It may be concluded that aortic banding in neonatal rats not only increased LV weight but also that of RV; these changes were accompanied in both ventricles by marked protein remodelling.

SEQUENTIAL AND ONE-STEP METHODS FOR INTERPRETING VCG DATA. D. Valová, Z. Drška, A. Málková, Faculty of Physical Education and Sports, Charles University, Prague, Czech Republic.

Discriminant analysis (DA) and the probabilistic expert system (PES) were used for VCG data interpretation. The classification was performed in two ways: the sequential approach (first step: differentiation of healthy subjects (H, 182) from patients with old myocardial infarction (MI) and second step: subjects belonging to the first group as patients with MI were classified into two subgroups according to the localization (MIP, 182) and (MIA, 164) and then the one step approach was used. The classification results of the DA sequential approach were equal to 83.0 %, 73.1 %, 69.8 % and the results of the DA one step approach were equal to 83.6 %, 78.5 %, 83.9 % respectively. PES sequential results were 95.9 %, 83.9 %, 95.1 % and PES one step results were 96.1 %, 83.6 %, 94.1 %. These results should prefer the one step method, because the method is much simpler and the classification results are nearly the same (PES) or better (DA) than the results of the sequential method.

BAROREFLEX SENSITIVITY AND RESPIRATORY ARRHYTHMIA DURING SYNCHRONIZED RESPIRATION IN PATIENTS AFTER MYOCARDIAL INFARCTION. N. Honzíkova, B. Fišer, B. Semrád¹, L. Lábrová¹, Department of Physiology and ¹First Internal Clinic, Faculty of Medicine, Masaryk University, Brno, Czech Republic.

The high frequency component (HF) of the spectra of fluctuations of cardiac intervals (respiratory arrhythmia) as well as the heart rate baroreflex sensitivity (BRS) are mediated by the vagal nerve. In this study, HF and BRS were compared in 8 control subjects (C) and 30 patients 7-19 days after myocardial infarction (P) using synchronized breathing (20 breaths/min for 2 min) and spectral analysis of cardiac intervals and blood pressure (the Peňáz method). Only absolute HF values were significantly decreased in group P, Wilcoxon test $p < 0.01$ (P: $32.07 \pm 35.39 \text{ ms}^2$, 0.074 ± 0.062 relative units; C: $84.74 \pm 56.11 \text{ ms}^2$, 0.075 ± 0.044 relative units). The correlation coefficient between BRS and HF was significant in P only ($r = 0.42$, $p < 0.01$). Nevertheless, the data concerning the activity of the vagus nerve obtained by both methods are dissimilar and indicate that the underlying events are more complex.

INFLUENCE OF LANTHANUM (La^{3+}) AND GADOLINIUM (Gd^{3+}) IN THE TIP OF A SUCTION ELECTRODE ON THE SHAPE OF EPICARDIAL MONOPHASIC ACTION POTENTIAL (MAP) IN THE FROG HEART VENTRICLE. *J. Slavíček, O. Kittnar*, Institute of Physiology, First Faculty of Medicine, Charles University, Prague, Czech Republic.

While tetrodotoxine (TTX) in the tip of a suction electrode decreased the following epicardial MAP amplitude, 4-aminopyridine (4-AP) and tetraethylammonium (TEA) increased it. Verapamil (V) tended to affect the duration of repolarization (2). In the present work, $\text{LaCl}_3 \cdot 7\text{H}_2\text{O}$ (Fluka), and Gd_2O_3 (Merck) $0.1-10.0 \text{ mmol.l}^{-1}$ have been applied in the same way in 20 frogs *Xenopus laevis in situ*. Cd^{2+} is known as a blocker of stretch-activated channels (1). MAPs were prolonged both after La^{3+} and after Gd^{3+} without significantly affecting the MAP amplitude. In summary, La^{3+} and Gd^{3+} mainly affected MAP duration similarly as V, while the effect of monovalent cation blockers was more pronounced on MAP amplitude.

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QUANTITATIVE MODEL OF INTERACTION OF 4-AMINOPYRIDINE WITH TRANSIENT OUTWARD CURRENT CHANNELS IN THE HEART. *J. Šimurda, G. Christé, M. Šimurdová, J. Moudr*, Faculty of Medicine, Masaryk University, Brno, Czech Republic and INSERM U121, Bron, France.

4-aminopyridine (4-AP) inhibits transient outward current (I_{to}) in the heart muscle in a use dependent manner (1). The aim of this study was to confront the experimental results with the modulated receptor hypothesis (MRH) based on the assumption that there is interaction between the drug-receptor reaction and the channel gating system. According to a simple version of the model, the unblocked I_{to} channels undergo transitions among one closed, one open and two inactivated states. The effect of the drug on activation is regarded as negligible while inactivation and blockade of the channel exclude each other. The rate constants of drug-receptor reactions depend on both the state of the channel and membrane voltage. A comparison of simulations on the model with experimental data (drug concentrations 1, 2 and 4 mM) fully confirmed the applicability of MRH to 4-AP block of I_{to} in cardiac cells with all its special features (1).

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CORRELATION BETWEEN CYTOSOLIC CALCIUM AND SODIUM PUMP ACTIVITY IN MUSCLE FIBRES. *T. Stankovičová, E. Amler, M. Burkhard, P. Švec, F. Vyskočil*, Faculty of Pharmacy, Department of Pharmacology and Toxicology, Bratislava, Slovak Republic and ¹Institute of Physiology, Academy of Sciences of the Czech Republic, Prague, Czech Republic.

The effect of 10 mM calcium and some of the calcium channel blockers on the electrogenic Na^+ -pump activity of mouse diaphragm muscle fibres enriched with sodium have been correlated with the changes in cytosolic Ca^{2+} levels. The mouse diaphragm, the basal level of cytosolic Ca^{2+} measured by the fluorescent indicator fura-2AM was $261 \pm 6 \text{ nM}$. After four hours of incubation in a K^+ -free, 2 mM Ca^{2+} solution, the cytosolic Ca^{2+} in the diaphragm increased to $314 \pm 28 \text{ nM}$. An increase in Ca^{2+} from 2 to 10 mM in the incubation medium caused a twofold increase of cytosolic calcium and inhibited electrogenic Na^+ -pump activity. This rise in the calcium level was similarly the Ca^{2+} -induced inhibition of the electrogenic pump, prevented by calcium channel blockers.

AGE-DEPENDENT VARIABILITY IN POSTURAL BLOOD PRESSURE AND HEART RATE REACTIONS IN CHILDREN. *D. Andrásyová, E. Kellerová, V. Regecová*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Comparative studies in the elderly and some data available from children and teenagers, based on the mean values, indicate age-dependent differences in the postural blood pressure (BP) and heart rate (HR) response. Our previous results have shown that a baroreceptor response to a head-up position is already developed in physiological newborns, but which is different from that, generally accepted as normal in healthy adults. In the present study, an individual quantitative and directional analysis of the different types of BP and HR responses to the upright posture and their ratio were assessed in 265 full-term newborns, 34 premature and in 1544 preschool children. In the majority of the full-term newborns (66%), systolic and/or diastolic BP as well as HR increased in the early steady-state head-up position. This "hypertonic type" of reaction is significantly less frequent and of smaller amplitude in preterms and its incidence decreases with age in preschool children. The type of the postural response is at least partly related to the initial supine levels of PB and HR.

TOTAL RESPIRATORY IMPEDANCE DURING HIGH FREQUENCY OSCILLATION VENTILATION. *I. Šipinková, E.A. Koller, J. Kohl*, Institute of Physiology, Medical Faculty, Comenius University, Bratislava, Slovak Republic and ¹Department of Physiology, University of Zürich, Zürich, Switzerland.

Mechanical properties of the chest-lung system during high frequency oscillation ventilation (HFO) were studied by means of mechanical respiratory impedance (Zrs) measurement in rabbits before and after bilateral vagotomy. Ten anaesthetized rabbits (3.1 kg mean body weight) were subjected to short runs of HFO with differing stroke volumes (5.0 ml, 6.6 ml, 10.0 ml) and oscillation frequencies (10 Hz, 15 Hz, 20 Hz, 25 Hz). Zrs was computed as the complex ratio of pressure and flow signals simultaneously measured at the airway opening. Zrs was characterized by its real (Rrs) and imaginary (Xrs) component. Vagotomy resulted in a profound decrease in Rrs and Xrs. At a fixed oscillation frequency, Rrs in the vagotomized animals was independent of the stroke volume whereas a stroke volume dependence was present in the intact animals. The results suggest that the respiratory reflex reactions occurring during HFO are vagally mediated and depend on the selected ventilatory parameters.

COMBINED EFFECT OF NOISE, PHYSICAL STRAIN AND HOT ENVIRONMENTAL CONDITIONS ON THE AUDITORY AND EQUILIBRIUM APPARATUS OF MAN. *J. Baláz, M. Janoušek, I. Borský, K. Hattar, L. Hubáčová, M. Bašňák*, Institute of Preventive and Clinical Medicine, Bratislava, Slovak Republic.

The physiological response of 20 healthy men (25.5 years old), exposed to a combined noise (90 dB), muscle work (100 W) and thermal (air temperature 21 °C and 33 °C) load was evaluated. During one-hour examinations we registered indices of cardiovascular and thermoregulation functions and by "ante-post" method we carried out audiometric and stabilometric examinations. In this paper, the results of stabilometric and audiometric examinations are presented. A shift in the threshold of hearing at the frequency of 4 kHz was significant in all the situations with noise application. The hearing threshold increased by about 15 dB on the average. The return to the initial values was prolonged with the increased number of factors applied. Normal threshold values were obtained within 60 min in the experimental situation of 21 °C, 90 dB and 0 W in 95 % of examined persons. In the situation of 33 °C, 90 dB and 100 W the values returned to normal within 60 min in 70 % of persons. The duration of stabilograms increased significantly during exposure to noise. The physical load significant decreased the length of stabilograms.

III. Neurophysiology, Endocrinology, Metabolism, Varia

FUNCTIONAL RESPONSE TO 30-MIN INTENSIVE EXERCISE UNDER ACUTE EXPOSURE TO NO_x AND SO₂. J. Heller, T. Doležal¹, Z. Holeček, Biomedical Research Centre and ¹Department of Sports, Faculty of Physical Education and Sports, Charles University, Prague, Czech Republic.

Functional response to bicycle exercise (3 W.kg⁻¹) lasting 30 min was followed in 8 volunteers (6 males and 2 females, age 22±2 years) under 3 experimental conditions: acute exposure to 500 µg.m⁻³ of NO_x, 500 µg.m⁻³ of SO₂ and in a normal environment (30 µg.m⁻³ NO_x and 30 µg.m⁻³ SO₂). The heart rate, ventilation, oxygen uptake and ratings of the perceived exertion during exercise were slightly higher in NO_x and SO₂ testing trials than in the control test. These differences were not, however, significant. Pulmonary function (vital capacity, FEV₁) and haematological parameters followed before and after exercise were not altered by the environmental conditions. Blood lactate after NO_x exercise decreased more slowly (*p*<0.01) than in SO₂ and the control test. Pulmonary retention attained 70–76 % for NO_x and 80–90 % for SO₂ and the absorbed dose during 30 min exercise was 0.55–0.85 g NO_x and/or 0.63–0.92 g SO₂. Despite this, the acute exposure to NO_x and SO₂ exerts only a small effect on the functional state of the organism.

II. Teaching Physiology in Medical Schools

UNIVERSAL COMPUTER PROGRAM FOR DIDACTIC TESTS. J. Chytil, J. Petřek, Institute of Physiology, Medical Faculty, Palacký University, Olomouc, Czech Republic.

Current problems in pregradual education of future physicians cannot be solved by traditional pedagogical methods. As changes in curricula are insufficient, they have to be accompanied by changes in the technology of teaching. These should be directed especially to selecting suitable teaching and evaluation strategies and to the choice of useful teaching aids. In this context, a computer represents a functional and perspective tool. We therefore developed a universal computer program for didactic as well as examination purposes in physiology and other medical disciplines. The program can be used either in personal computers (*GrafTest*) or in computer networks (*NetTest*); both types were presented in detail during the meeting. *NetTest* as well as *GrafTest* can be applied in testing the knowledge of students either during or before the examination. The latter application is especially valuable since the student is provided with feedback information on the result of his previous learning activity. Moreover, the student is taught self-evaluation which subsequently helps him to programme his own learning strategy.

SOFTWARE SYSTEM OF THE MOIRE FRAME INTERPRETATION FOR IDIOPATHIC SCOLIOSIS. D. Valová, M. Chalupová, Faculty of Physical Education and Sports, Charles University, Prague, Czech Republic.

To avoid frequent X-ray exposure of children suffering from idiopathic scoliosis during the whole treatment, we prefer to determine the shape changes and the type of spine deviation by the optical Moire method. This method provides information not only about changes of the spine but also about the state of the thoracic musculature. The distribution of surface muscle tone, determined by palpation, also contributes to the general assessment. The presented software system makes it possible to show the curvature of the spine in both anteroposterior and lateral planes, probable surface muscle tone distribution, to compare the present state with previous findings and to compute the quantitative parameters (peak values and peak positions, Cobb angles, compensation, etc.). The figures are supplemented with their description, parameters and suggested exercises. This system is open to the future users' suggestions.

DOES THE SYSTEM OF NO-SYNTHASE TAKE PART IN THE GENESIS OF SPONTANEOUS MOTILITY IN CHICK EMBRYOS? J. Sedláček, First Faculty of Medicine, Charles University, Prague, Czech Republic.

NMDA-sensitive mechanism and NO putatively participate in the neural genesis of spontaneous motility in chick embryos. We attempted, by means of acute application of L-arginine and *N* ω -nitro-L-arginine methylester, to influence and to prove the participation of NO synthase and to confirm our preliminary assumption. 1. L-arginine (20 mg/kg e.w.) activated spontaneous motility even in 11-day-old embryos. A double dose increased the enhancing effect in 13- and 15-day-old embryos. 2. Methylester (20 mg/kg e.w.) depressed the effect in 17-day-old embryos only. Its ineffectivity till day 15 did not depend on the dose. 3. The simultaneous or successive application (10 min interval) of both drugs in 17-day-old embryos repeated the activatory effect of L-arginine and depressive effect of its methylester. The results support the putative participation of NO as a factor maintaining the activation of NMDA-sensitive neural system in the genesis of embryonic spontaneous motility.

CALCIUM, SWELLING AND ISCHAEMIC BRAIN DAMAGE. P. Jalč, J. Maršala, H. Jalčová¹, Institute of Neurobiology and ¹Institute of Experimental Physics, Slovak Academy of Sciences, Košice, Slovak Republic.

Adult rats were submitted to 30 min cerebrocirculatory arrest, followed by blood recirculation for 24 h. Calcium sequestration was measured in the cerebral cortex and hippocampus, and compared with ultrastructural damage as assessed electronmicroscopic cytochemistry. In animals without postischaemic hyperoxia, neither the calcium content nor mitochondrial calcium sequestration were significantly increased in the cerebral cortex or hippocampal subfield CA1. Calculation of tissue swelling did not reveal any change in the cerebral cortex, but a volume increase in the hippocampus indicated the development of brain oedema in this region. In animals with postischaemic hyperoxia, tissue calcium significantly increased both in the cortex and hippocampus. Calculation of tissue swelling revealed a volume increase in the cortex and also in the hippocampus. The results obtained do not support the hypothesis that selective vulnerability of the hippocampus is as consequence of neuronal calcium overload, but rather indicate that calcium accumulation is an unspecific epiphenomenon of irreversible cell injury.

HIPPOCAMPAL GRANULAR LAYER LESION: I. DENDRITIC PLASTICITY OF THE NEIGHBORING NEURONES. J. Pokorný, J. Mareš, Institute of Physiology, Faculty of Medicine, Charles University, Prague, Czech Republic.

Fluid injection into the intragranular cleavage plane of the dentate gyrus dorsal blade brakes axons and causes disintegration of the granule cells, accompanied by a shrinkage of the molecular layer. It can be assumed that it is followed by a considerable rearrangement of afferent connections in the neighboring neuronal circuits. Distribution of dendritic spines in the CA3b pyramidal cells and in granule cells of the ventral blade was estimated in Golgi impregnated material. In five days or two months intervals, pyramidal cells displayed loss of spines (mossy terminals) on their shafts of apical dendrites. In proximal segments of the basal dendrites the spine density increased. In the ventral blade at the same time, the density of spines increased in proximal segments of granule cells. The above described changes were not fully expressed after five days after the operation. We thus conclude that after the damage of the part of the granule cell layer a significant redistribution of both the input and output fibers to the remaining cells takes place. It might explain some functional changes found in the same material.

HIPPOCAMPAL GRANULAR LAYER LESION: II. ELECTROPHYSIOLOGICAL CHANGES. *J. Mareš, J. Pokorný,* Institute of Physiology, Faculty of Medicine, Charles University, Prague, Czech Republic.

Impairment of dentate granular cells in the dorsal blade was achieved by a fluid injection into the intragranular cleavage plane of adult rats, similarly as in previous experiments. Cleavage in the corpus callosum or a distinct cleavage in the fissura hippocampi of experimental animals together intact animals served as the control. Three to five days later, the right frontal cortex was repeatedly (four times) electrically stimulated (8 Hz, 20 s). All rats responded by epileptic after-discharges (ADs). Repetition of seizures (10 min intervals between seizures and next stimulation) included clear signs of acute kindling. The shape and duration of ictal discharges in the experimental group did not substantially differ from that of intact controls. Spike-and waves (3 s^{-1}) prevailed in most of these seizures. The animals with cleavage in fissura hippocampi showed more serious ADs with prevalence of serrated waves in comparison with the controls and other operated animals. The shape of seizures in the experimental group with cleavage in the granular layer did not exhibit such profound differences. This dissimilarity diminished two months later. It is possible that damage in the region of fissura hippocampi may cause greater involvement of the hippocampus in epileptic ADs than the partial disruption of intrahippocampal connections, mediated by gyrus dentatus.

AN INSTRUMENTAL CONDITIONING PROCEDURE FOR AUDITORY TESTING IN RATS. *G. Brožek, J. Syka¹, N. Rybalko¹, J. Popelář¹, M. Jílek¹,* Institute of Physiology, Second Faculty of Medicine, and ¹Institute of Experimental Medicine, Czech Academy of Sciences, Prague, Czech Republic.

A computer operated setup for standard auditory testing in rats was developed. The rat was placed in an adapted Skinner box equipped with two levers and an automatic feeder. When the hungry animal was ready for stimulus presentation, it pressed the first (right) lever. After a random time interval (0.5 to 5 s), the short (1 s) acoustic stimulus was presented. If the rat pressed the second (left) lever during the sound the automatic pellet dispenser released one food pellet into the feeder. If the rat pressed the left lever before or after the sound, or if did not press it at all, it was not rewarded and the whole procedure was repeated: the rat had to press the first lever to start the cycle again. The application of the described method for hearing threshold assessment and its modification for other tasks is discussed.

NEUROTRANSPLANTATION AND DEGREE OF MATURATION OF EMBRYONAL NEURONES. *M. Langmeier, J. Pokorný, S. Trojan,* Institute of Physiology, First Faculty of Medicine, Prague, Czech Republic.

Optimal survival of embryonal neurones, used in transplantation studies, coincides with the period of early differentiation of each neurone type. For rat hippocampal neurones this occurs at the age of 18–20 embryonal days. Routine microscopical methods only reveal cell bodies. We employed a modified phase contrast method for living and unstained cells (Nomarski) to examine the degree of development of neuronal processes in a material similar to that used in our transplanation studies. The degree of maturation of embryonal neurones in our suspension material differed considerably. All of the cells manifested some signs of immaturity, however, many of them appeared much more mature than might be expected from the Golgi impregnation study. During transplantation, the ratio of surviving neurones depends greatly on their stage of maturity. The high proportion of well developed neurones in twenty- and eighteen-day-old embryos can explain the comparatively low percentage of surviving neurones in our previous transplantation studies.

HISTOCHEMICAL ACTIVITY OF SOME ENZYMES IN SHEEP OVARIES DURING ANOESTRUS. *V. Eliáš, L. Kolodziejvski¹, J. Halagan, D. Pavlová, J. Várady,* Department of Physiology and ¹Department of Pathological Anatomy, University of Veterinary Medicine, Košice, Slovak Republic.

The use of qualitative histochemical methods was aimed at the observation of changes in the activities of alkaline phosphatase (ALP), acid phosphatase (AP), nonspecific esterase (NE), adenosine triphosphatase (ATP) and 5-nucleotidase (5'-N) in the sheep ovary after normal stimulation with follicotropin in a total dose of 24 and 30 mg FSH in 14 sheep during anoestrus. The activity of the above enzymes was subjectively evaluated in the wall of tertiary follicles and in the corpus luteum. Marked changes were recorded in the activity of AP and NE in the follicular wall in tertiary follicles in the experimental sheep. These are considered to indicate that the changes are connected with the atretic process. Intensive activity of all the enzymes determined was observed in luteal cells of the corpus luteum in control as well as in the experimental sheep.

SOME HORMONAL AND ANTIPROTEOLYTIC CHARACTERISTICS OF FOLLICULAR FLUID AND BLOOD PLASMA OF SHEEP AFTER SUPEROVULATION STIMULATED EWES. *M. Molnárová, J. Pržala¹, J. Arendarčík, P. Molnár,* Department of Physiology, University of Veterinary Medicine, Košice, Slovak Republic and ¹ART, Olsztyn, Poland.

Superovulation stimulation transforms the antiproteolytic activities (AA) and concentrations of estradiole (E_2), progesterone (P_4) and androstendione (A_4) in the blood plasma and follicular fluid. These changes effect local regulatory mechanisms and thus influence the success of stimulation. The individual responses of ewes to superovulation stimulation has not, as yet, been fully explained. PMSG treatment has some unfavourable side effects. These are time dependent. We provided stimulation by a combination the following hormones – FSH, HCG, PMSG, in two subsequent ovarian cycles or by shortening the time of the effect of the PMSG by injection of anti-PMSG. Hormonal profiles of E_2 , P_4 and A_4 in the blood plasma and AA and concentrations of E_2 , P_4 and A_4 in the follicular fluid support observations that the phase of the ovarian cycle, in which treatment was started, is a limiting factor in successful superovulation stimulation.

CATECHOLAMINE LEVELS AND MONOAMINOXIDASE ACTIVITY IN THE HYPHYPHYSIS AND BLOOD PLASMA OF EWES FOLLOWING HORMONAL STIMULATION WITH SERUM GONADOTROPIN. *B. Pástorová, V. Eliáš, J. Várady,* Department of Physiology, University of Veterinary Medicine, Košice, Slovak Republic.

The effect of hormonal stimulation on catecholamine levels and the activity of its degradation enzyme in the hypophysis and blood plasma of ewes during the oestric period was studied by the radioenzymatic method. The oestrus of ewes was synchronized with agelin sponges. After completed synchronization, we induced superovulation by means of serum gonadotropin. The results indicate that hormonal serum gonadotropin stimulation significantly increases ($p < 0.01$) pituitary dopamine and epinephrine levels in ewes. MAO activity in the hypophysis decreased significantly, almost by a half, in comparison to the control values. The results of our experiment also show that superovulation induces changes in plasma norepinephrine and dopamine levels during controlled ovulation of ewes.

ENDOGENOUS UREA AS THE ONLY NITROGEN SOURCE IN RUMINANT FEEDING. J. Váradý, K. Bodá¹, University of Veterinary Medicine, Košice and ¹Institute of Biochemistry and Genetics of Animals, Ivánka pri Dunaji, Slovak Republic.

Endogenous urea plays an important role in the exchange processes of nitrogen between the blood and the alimentary tract. Further metabolism of ammonia formed in the rumen as a final product of protein and urea break-down is the same. This means that urea of exogenous and endogenous origin may substitute a part of dietary protein. This fact prompted us to perform, exact experiments to learn the ability of the ruminant organism to satisfy its total nitrogen requirements from endogenous (i.v. injected) urea. The experiments were carried out on sheep fed a non-protein synthetic diet with urea (exogenous N-intake) or without urea (endogenous N-intake), when urea was administered intravenously for 3 months twice daily. The level of NH₃, the total and residual nitrogen and amino-N in the rumen fluid, the body weight, nitrogen balance and urea turnovers were measured. It was demonstrated in this way that ruminants are able to ensure sufficient nitrogen for total proteosynthesis in the forestomachs from endogenous urea nitrogen.

TERGURIDE ALLEVIATES GLUCOSE TOLERANCE ABNORMALITIES AND HYPERLIPIDAEMIA IN GENETICALLY HYPERTENSIVE RATS OF THE KOLEZTSKY TYPE WHEREAS BROMOCRIPTINE ALLEVIATES ONLY HYPERLIPIDAEMIA. V. Golda, L. Cvak¹, Institute of Experimental Neurosurgery, Hradec Králové and ¹Galena, Opava-Komárov, Czech Republic.

Total plasma cholesterol and plasma triglycerides as well as the glucose tolerance were controlled in genetically hypertensive obese rats of the Koletzky type and in their non-obese siblings. In these animals, we found elevated total plasma cholesterol as well as plasma triglycerides; the glucose tolerance curve showed abnormalities predominantly in the obese rats. Terguride administered in the dose 0.2 mg/kg i.p. for 21 days showed alleviation of hyperlipidaemia as well as a normalization of the glucose tolerance curve. Bromocriptine given in the dose of 2 mg/kg i.p. for 21 days showed only an alleviation of hyperlipidaemia. These data suggest that terguride can be considered for the therapy of human forms of hyperlipidaemia which are accompanied by glucose tolerance abnormalities.

EFFECT OF ARGININE-VASOPRESSIN ON PHOSPHATIDYL-INOSITOL METABOLISM OF RAT PINEAL GLAND. R. Novotná, I. Novotný, R. Krulík, Z. Zelenková, Department of Physiology, Faculty of Science and Laboratory of Psychiatry, First Faculty of Medicine, Charles University, Prague, Czech Republic.

The peptidergic innervation of the pineal gland contains arginine-vasopressin (AVP) fibres. The effect of AVP on pineal gland secretion or its metabolic activity is not known. The aim of the present study was to determine, how AVP mediates its effect on the plasmatic membrane in the pineal gland. Isolated rat pineal glands were incubated in a conventional incubation medium which contained 5 mM HEPES, glucose, 50 μ Ci ³²P-orthophosphate and AVP. The individual phospholipids were separated by thin layer chromatography on silicagel and their radioactivity was determined. The AVP concentration (AVP 10⁻⁵ M) led to a three-fold increase of ³²P-labelling into phosphatidylinositol (PI). The labelling of other phospholipids was not affected. An antagonist of AVP had no effect on ³²P labelling of PI. Activity of the cAMP-dependent protein kinase and phosphorylation of proteins were not changed. It is suggested that AVP activates the PI signal system in the pineal gland and has no effect on cAMP levels.

CALCIUM INDUCES INHIBITION OF (NA⁺+K⁺)-ATPase ACTIVITY NONCOMPLETIVELY IN RELATION TO SODIUM AND MAGNESIUM. A. Breier, Z. Sulová¹, A. Vrbanová, T. Stankovičová², Institute of Molecular Physiology and Genetics, ¹Institute of Chemistry, Slovak Academy of Sciences and ²Faculty of Pharmacy, Comenius University, Bratislava, Slovak Republic.

Calcium inhibited the activity of (Na⁺+K⁺)-ATPase from dog kidneys in a dose-dependent manner. Other cations in the 2A group of the periodic table, such as Sr²⁺ and Ba²⁺, were also able to inhibit the ATPase activity, but to a lesser degree. No appreciable competition between Ca²⁺ (Ba²⁺, Sr²⁺) and magnesium ions could be observed. Thus, these three inhibitory ions act on ATPase activity independently of their magnesium and/or sodium stimulation. This suggested that Ca²⁺, Sr²⁺ and Ba²⁺ ions probably inhibit enzyme activity by interacting with a distinct regulatory site. The specificity of such an interaction may be ensured by complementarity of the cation binding site geometrically reflecting the structure of Ca²⁺, Ba²⁺, Sr²⁺ in coordination with the number 8. Mg²⁺ may form coordination bonds up to coordination number six and do not interact specifically with this binding site.

SPONTANEOUS MOVEMENT OF GIANT CELLS ON THE INNER SURFACE OF AN INTRAOCULAR IMPLANTED LENS. I. Krekule, J. Novák¹, S. Saic², Institute of Physiology, Academy of Sciences of the Czech Republic, Prague, ¹Faculty Hospital, Charles University, Hradec Králové and ²Institute of the Theory of Information and Automation, Academy of Sciences of the Czech Republic, Prague, Czech Republic.

A spontaneous movement of cells may prove a new cue in clinical and experimental research, indicating the physiological state of a tissue. We refer to an attempt to describe such movement of single giant cells on the inner surface of an implanted intraocular lens by photorecording such cells *in vivo* by using its third Purkinje image observed through a slit biomicroscope and processed by an image analyzer. Movement of the cell was complex, consisting of translation, rotation, changes of its shape and flow of its cytoplasm. The translation of the cell was described by coordinates of the centre of gravity of the cell body and of its pigment vacuole at 12 and 24 h time intervals: rotation was assessed by the direction of the vector connecting the centre of gravity and the cell body and that of the vacuole. The cell body movement was chaotic, the cytoplasm flow estimated by the shape changes. The vacuole and the cell body rotations preferred a clockwise direction.

CHANGES IN BONES CAUSED BY VIBRATION. R. Rosenfeld, I. Kvapilová, J. Fialová¹, Institute of Physiology and ¹Department of Occupational Diseases, Medical Faculty, Palacký University, Olomouc, Czech Republic.

In the case of 76 woodcutters, whose upper extremities were exposed to excessive vibrations while working with power saws, the bone mineral density of the clavicles (1) was lower (88.5±1.5 %) compared to a control group of 132 healthy men who were not exposed to vibration risk (100.0±0.9 %). In the case of 30 woodcutters, after the vibration risk was eliminated, the bone mineral density of the clavicles increased to 96.1±2.2 of the value of the control group. Reversible osteoporotic changes in vibration disease may be caused by partial denervation (2) verified neurohistologically (3).

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PATHOPHYSIOLOGY OF JAW CONTRACTURE AND POSSIBILITIES OF ITS INFLUENCING BY VARIOUS ELECTROTHERAPEUTICAL METHODS. J. Fialová, E. Jirava¹, J. Jezdinský², J. Hálek³, Institute of Physiology, ¹Third Clinic of Stomatology, Teaching Hospital, ²Institute of Pharmacology and ³Institute of Medical Biophysics, Medical Faculty, Palacký University, Olomouc, Czech Republic.

In contractures following the tooth extraction and trauma, pronounced effectiveness of diadynamic (DD) currents was evidenced, while the electrophoresis of hyaluronidase (hyase elpho) revealed the best effect in contractures of inflammatory origin. The combined application of hyase elpho and DD currents did not bring any increase of therapeutical effect. The effectiveness of physical therapy decreased with the latency interval. An experiment on rats revealed that hyase elpho increased the area of Evans blue diffusion in the subcutaneous layer in the same extent as hyase applied intradermally. This finding confirms a good penetration of hyase into the rat subcutaneous layer during electrophoretic application.

HLA ANTIBODIES IN HUMAN RENAL TRANSPLANT CANDIDATES. E. Lenhartová, K. Lenhart¹, A. Bártova², I. Loučková³, Institute of Physiology, ¹Institute of Biology Faculty of Medicine, Palacký University, ²Department of Immunology, Faculty Hospital and ³Department of Sociology and Andragogics, Faculty of Philosophy, Palacký University, Olomouc, Czech Republic.

The level of anti-HLA antibodies was followed in 155 patients on a chronic dialysis programme against antigens of HLA Class I and HLA-DR antigens representing the HLA Class II. Correlation between the titre of these antibodies and additional factors was analyzed. The effect of pregnancy and consequently of sex has been demonstrated. The number of dialyses undergone and the time at which the patients were included in the dialysis programme were found to be significant. The positive correlation between the titre of both types of anti-HLA antibodies was so significant that it makes it possible to concentrate on simpler determinations of anti-HLA I antibodies.

INHIBITORY EFFECT OF THE BACTERIAL IMMUNOMODULAR OLIMUNOSTIM ON MASTOCYTE DEGRANULATION IN VITRO. A. Merkunová, M. Hajdúch¹, E. Weigl¹, Institute of Physiology and ¹Institute of Immunology, Faculty of Medicine, Palacký University, Olomouc, Czech Republic.

A bacterial immunomodulator, Olimunostim (OS), activates the mechanisms of nonspecific immunity. In clinical practice, it is applied above all in chronic infections of bacterial, viral or fungal origin, frequently in recurrent infections of the upper respiratory tract and infectious complications of asthma bronchiale. The possible role of OS in the process of histamine release was studied on a population of rat peritoneal mastocytes (PMC), isolated by a routine technique of peritoneal washout and incubated in a medium with OS (4.3.2.1 mg.ml⁻¹ of the medium). The PMC degranulation was stimulated by component 48/80. The amount of histamine (HI) in the supernatant and in the pellet PMC was determined by the fluorometric method. The substance of HI nature were also evaluated in OS (lysate of bacterial bodies of *S. aureus*, *K. pneumoniae*, *P. acnes*). These observations may serve as evidence for a dose-dependent inhibitory effect of OS on the degranulation of rat PMC. It was found that OS used in clinical practice contained approximately 1 µg HI in one tablet (9 mg of active substance).

IV. Microsymposium on Oxygen Radicals – Trends in Contemporary Research (8th Neuroontogenetic Round-Table)

LIPID PEROXIDATION IN HYPOXIC AND REOXYGENATED RAT BRAIN. J. Koudelová, J. Mourek, Institute of Physiology, First Faculty of Medicine, Charles University, Prague, Czech Republic.

Hypoxic and hyperoxic damage of cells is considered to be caused by production of reactive oxygen metabolites at rates which exceed the detoxifying capacities of the cells' antioxidant defense mechanism. Male and female young and adult Wistar rats were exposed to hypobaric hypoxia for 30 min (barometric pressure 30.7 kPa, pO₂ 6.4 kPa). After this, the experimental animals were reoxygenated in an atmosphere of pure oxygen under normobaric conditions and air at room temperature. Malondialdehyde as a secondary product of lipid peroxidation was determined in the brain cortex, subcortical structures, medulla oblongata and cerebellum. After 30 min exposition to pure oxygen, malondialdehyde production increased in all the studied areas of the male brain, but not in the female brain. Hypoxia and reoxygenation with pure oxygen increased malondialdehyde production in male and female young rats. There is no difference between reoxygenation by pure oxygen and by air. Only small changes were found in malondialdehyde production of the brain cortex and subcortical structures of adult animals.

THE EFFECT OF SHORTLASTING STARVATION ON LIPID PEROXIDATION IN THE BRAIN OF RATS OF VARIOUS AGES. J. Mourek, J. Koudelová, Institute of Physiology, First Faculty of Medicine, Charles University, Prague, Czech Republic.

The experiments were performed on rats of our own bred (Wistar), aged 5 and 90 postnatal days, in which the effect of 24 hours' fasting on lipid peroxidative processes was followed in various parts of the brain. Young rats were, for the mentioned period of time, separated from their mother (under thermostable conditions), the adult rats were deprived of food. Using the method of Ohkawa *et al.* (1) the concentrations of malondialdehyde in the brain cortex, subcortical structures, the cerebellum and medulla oblongata were measured. In the adult rats, an evident and significant difference in the MDA production in females and males was observed; in females, the amount of MDA was always significantly lower than in the males. In the females, the nutritional stress caused no changes in the level of lipid peroxidation in the brain, in the males lipid peroxidation in the medulla oblongata was lowered. In young rats, the short term fasting significantly elevated the MDA production (i.e. lipid peroxidation) in the cerebellum and the medulla. The obtained results are compared with previous data concerning peroxidation in the brain after hypoxic stress in the same age groups of rats (1).

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LIPOPEROXIDE FORMATION BY ISOLATED MEMBRANES FROM THE RAT BRAIN, HEART AND KIDNEY. Z. Drahota, H. Rauchová, J. Mourek¹, J. Koudelová¹, Institute of Physiology, Academy of Sciences of the Czech Republic and ¹Institute of Physiology, First Faculty of Medicine, Charles University, Prague, Czech Republic.

The maximum capacity for thiobarbituric acid reactive substances (TBARS) as indicator of lipoperoxide formation was determined in isolated membranes from the brains of 7, 21 and 90-day-old rats and from the heart and kidneys of 90-day-old rats. Peroxidation was induced during *in vitro* incubation by NADPH/ADP/Fe of by ascorbate/ADP/Fe. Higher TBARS production was found in the brain than in the heart or kidney. These values were not age-dependent in the brain. The higher TBARS production in brain membranes correlated with the higher amounts of phospholipids in isolated membranes. The increase of TBARS in the brain, heart and kidney membranes inhibited the activity of Mg-dependent ATPases and activated Mg-independent ones.

PROTECTIVE EFFECT OF VITAMINS C AND E DURING HYPOXIA. *M. Schreiber, S. Trojan*, Institute of Physiology, First Faculty of Medicine, Charles University, Prague, Czech Republic.

The authors have demonstrated the protective effect of administration of vitamins C and E on the resistance of laboratory rats to hypoxia. In the first experiment, rats – controls and those treated with ascorbic acid (AA) $1 \text{ mg}\cdot\text{g}^{-1}$ s.c. 1 h before the exposure – were exposed for 1 h to high altitude in a hypobaric chamber and the mean lethal altitude were assessed. AA displayed a protective effect, so that, in two identical experiments, the mean lethal altitude was 10 900 and 10 150 m in the controls and 11 500 and 11 450 m in AA treated animals. In the second experiment, an increase in brain superoxide activity was found in rats exposed to high altitude hypoxia (7 000 m, 30 min daily for five days) and AA treatment ($1 \text{ mg}\cdot\text{g}^{-1}$ s.c.). No significant changes were observed after altitude hypoxia of AA alone. Vitamin E in a dose of 150 mg and 300 mg/kg of body weight, administered i.p., has a protective effect throughout the whole ontogenesis as compared to stagnant hypoxia induced in the laboratory rat by positive radial acceleration (10xg). The favourable influence of vitamin E is relative greater in older animals.

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NITRIC OXIDE IN EARLY INHIBITORY LEARNING – AN EFFECT OF OXYGEN RADICALS? *J. Mysliveček, J. Safanda, J. Hassmannová*¹, Institute of Pathophysiology, Medical Faculty, Charles University, Pilsen and ¹Institute of Normal and Clinical Physiology, Third Faculty of Medicine, Prague, Czech Republic.

The impact of nitric oxide (NO) on inhibitory learning in newborn rats was studied by our method of passive avoidance using pup activation by gentle air-flow (1), and their memory was evaluated by a retention index (2). Blockade of NO-synthase by L-nitroarginine significantly and dose-dependently (5 mM, 10 mM, $1 \text{ ml}\cdot 100 \text{ g}^{-1}$ i.p.) impaired learning, memory processing, as well as retrieval after a 24-hour interval. On the contrary, L-arginine (20mM) improved all these functions and partially antagonized the influence of nitroarginine. Various, already known, relationship between NO and oxygen radicals, regulatory and reciprocal interactions of NO and oxygen metabolism, as well as the borderlines between the positive and toxic effects of neurotransmitters are discussed.

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PROTECTIVE EFFECT OF ASCORBIC ACID DURING INHALATION EXPOSURE OF GUINEA-PIGS TO INDUSTRIAL DUST. *Z. Kováčiková, E. Ginter*, Institute of Preventive and Clinical Medicine, Bratislava, Slovak Republic.

Toxicants can upset cellular redox balance. We have speculated that higher levels of ascorbic acid, a naturally occurring antioxidant, could protect the lungs during inhalation exposure to industrial dust. Male guinea-pigs which, similarly as man, are not capable of synthesizing ascorbate, were used in the experiment. They were exposed for 4 weeks (5 days per week, 5 hours daily) to real industrial dust, which consisted predominantly of heavy metal oxides. The animals were divided into 4 groups. Two groups served as the controls and two were exposed to the inhalation. The drinking water of one exposed and one control group was supplemented with $1 \text{ g}\cdot\text{l}^{-1}$ of ascorbic acid. The animals were killed after discontinuing the exposure. The content of ascorbic acid in the lungs and early markers of lung damage were estimated (acid and alkaline phosphatase, lactatedehydrogenase). The protective effect of ascorbic acid during the inhalation exposure was clearly demonstrated.

THE INFLUENCE OF DIFFERENT VITAMIN C INTAKE ON TISSUE LPO LEVELS IN FEMALE GUINEA-PIGS. *D. Čerhata, E. Ginter, A. Hudcová*, Institute of Preventive and Clinical Medicine, Bratislava, Slovak Republic.

Female guinea-pigs were given different doses of vitamin C with logarithmic gradation (1–10–100 mg/animal/day) for 9–11 weeks. Vitamin C was added as L-ascorbic acid to drinking water. Different intake of vitamin C caused differences in tissue vitamin C levels. The lowest dose (1mg) ensured normal animal growth, but the vitamin C levels approached marginal deficiency. The highest dose (100mg) enabled "tissue saturation", i.e. maximum steady state levels. Amounts of malondialdehyde as an indicator of the level of lipidperoxidation determined by HPLC were significantly increased in the adrenals and liver of the group with the lowest vitamin C intake. In both these organs, a statistically significant negative correlation was found between lipidperoxide levels and ascorbic acid concentration. These results prove the antioxidant effect of vitamin C which inhibits the oxidative transformation of polyunsaturated fatty acids.